THE EFFECTIVENESS OF A FLOOD WARNING: A CASE STUDY OF TROPICAL STORM FRED IN WESTERN NORTH CAROLINA

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INTRODUCTION

This study exposes a need for empowerment in Western North Carolina's (WNC) response capacity to emergency warnings. From the individual household to community and municipal levels, the success of a warning is dependent on the ability to respond appropriately. This dependence is a key motivation for this research. A rapidly changing climate is causing an increase in extreme flooding events in WNC. Preparing vulnerable communities is critical to the path of response capacity.

Therefore, an analysis is performed between a vulnerability map and Tropical Storm (TS) Fred precipitation to understand how to improve the efficacy of emergency alerts. Analyzing this data across the region can support future planning and communication processes. Additionally, a survey presents evidence that explores the response capacity of warning recipients. This research conveys that people frequently do not know how to respond; therefore, the warnings suffer in efficacy. The problem is exacerbated by compounding warnings with confusing instructions, for example, during TS Fred, when multiple warnings and alerts were issued. Some areas received both tornado and flash flood warnings. One instructs the recipient to move to the home's lowest, most interior place; the other requests an evacuation to higher ground. According to National Centers for Environmental Information's (NCEI) Mr. Jake Fortune (2021 personal communication), the meteorological community is challenged by compounding warnings. A safe place during a tornado may be a basement, yet going to a basement to escape a flood is not secure. This is a tricky situation for everyone, leaving warning recipients to choose their response based on their environment and the timing of the warning.

For a flood warning to be effective, recipients must have a high response capacity. This means people are prepared to respond to and recover from the hazardous impacts of climatic events with minimal mental, emotional, physical, or financial damages. People who are climate resilient have high response capacity.

From 16-19 August 2021, the remnants of TS Fred dropped over nine inches of rain in Asheville, NC (WRAL 2021), causing flooding throughout the area. On 8 September, President Joseph R. Biden, Jr. declared the event a significant disaster and

issued supplemental funding to support recovery efforts (Biden 2021). As of 6 October 2021, Haywood County residents had received over $7.7mil in federal funding to support recovery efforts (FEMA 2021). The decision-making community must know if people were adequately prepared for the disaster. Six deaths were among the adverse impacts of this weather event, which may have been avoidable through increased teamwork and education between governing authorities and the general public. Disaster Risk Reduction (DRR) efforts carry success if the most vulnerable populations are empowered. If a community is resilient and knows what to do in a flood crisis, then the chance of a sustainable recovery increases (Kreibich 2021). Effective flood warnings can turn devastating social and environmental impacts into opportunities for social transformation by shifting the focus from recovery to preparedness. Strengthening hazard mitigation and climate adaptation lies within the most vulnerable communities, where the potential for loss of life or property is the greatest (Baudoin 2014). Being prepared in our weakest areas is vital to increasing response capacity.

Song (2020) and Baudion (2014) show that livelihood resilience relies considerably on self-organizing processes, crowdsourcing, and community participation. Technology and data are helpful for planning and mitigation, but they are only half the solution to proper adaptation. Perera (2020) suggests that enhancements should be added to real-time flood warnings to make them more effective. Song (2020) suggests community engagement with emergency warnings is required to ensure resilience.

The social science aspect of this research focuses on people's response behavior and presents the importance of community engagement efforts to improve this capacity. Are people empowered to take emergency response action? The results use physical and social science-based data to uncover areas in WNC where resilience is needed. The evidence conveys the need for community-oriented solutions.

The research begins with a section called Study Design, in which the methodology used is divided into four sections: TS Fred impact, vulnerability map, and survey results. This is followed by sections including discussion, recommendations, and a brief conclusion. Appendix A is a list of local resources garnered during the research that can be used for WNC constituents as an agency of empowerment.

STUDY DESIGN

To understand how to improve the efficacy of emergency alerts, I first identify the locations of WNC's most vulnerable populations using data from the SVI (Social Vulnerability Index) (ATSDR, 2020) and the CRE (Climate Resilience Estimates) (Willyard, 2020). These demographics include populations with three or more high-risk factors. A third flood risk data layer shows the low-lying areas more prone to flooding, especially in the Pigeon River Basin, where flooding often occurs. A map shows areas where high-risk socioeconomic factors and high flood risk correlate. Then, I compare this to TS Fred's precipitation data and damages. Analyzing this data across the region can support emergency managers, decision-makers, and governing authorities in their future processes.

Through further research conducted by firsthand interviews, email correspondence, and a survey, I present evidence that explores the response capacity of people who receive the warnings. Using the survey, the research shows common areas in how alert messages are received and understood.

a. Tropical Storm Fred's Impact

TS Fred impacted WNC from 16-19 August 2021, increasing the monthly precipitation to the 3rd highest on record. August precipitation totals ranged from 150-200% of normal for the area. As NCEI's most recent climate report (NCEI, 2021) states, "a station just north of Lake Toxaway in Transylvania County, NC, measured a total of 23.41 inches (595 mm) of rain for the event." Twenty-one tornadoes (EF-0 & EF-1) occurred within TS Fred from 16-18 August, mostly occurring further south and just east of Asheville city, according to the Southeastern Regional Climate Center (SERCC). According to FEMA, TS Fred was reported to have dropped over a foot of rainfall in some locations of WNC. Most significantly, rainfall on 18 August in the "Balsam Range area caused significant flash flooding in the headwaters of the Pigeon River in southern Haywood County, NC, and the headwaters of the French Broad River in Transylvania County, NC." (SERCC 2021) TS Fred's heavy rainfall and strong thunderstorms in the higher elevations created flash flooding that uprooted hundreds of trees, throwing dangerous debris downstream. Figure 1 below shows the total rainfall for 18 August 2021, according to NOAA.

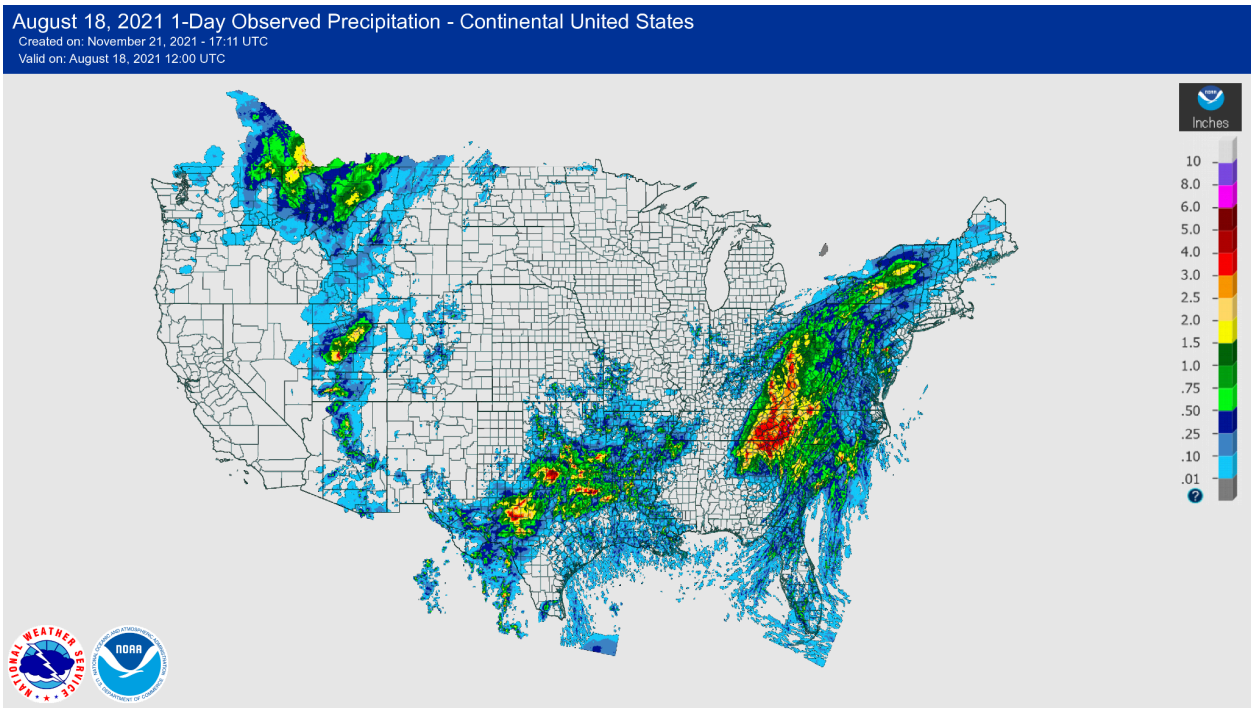

Figure 1 shows the total rainfall for 18 August 2021, according to NOAA. (https://water.weather.gov/precip/ accessed 26 Oct 2021)

NC Governor Roy Cooper declared a state of emergency for North Carolina on 18 August. The flooding and landslides swept multiple recreational vehicles downstream and damaged homes. According to Zack Koonce (2021, personal communication) of the Haywood County Emergency Services Office, 92 private bridges or culverts were damaged, and 40 state bridges or culverts suffered damages. As of 13 November 2021,

the NCEI stated that approximately $300 million in damages occurred in Haywood County. According to the same report, using the August 2021 County Level Risk map, TS Fred incurred a total of $1.3 billion in total loss and damages throughout the Southeastern U.S. According to a press release following the Executive Order (EO) signed by Gov. Roy Cooper on 18 August, Haywood County was the most severely impacted by the torrential rainfall caused by TS Fred. Eight WNC counties also declared states of emergency and have applied for further federal funding. Interestingly, the EO directly states the need for greater collaboration for DRR: “WHEREAS, N.C. Gen. Stat. § 166A-19.1(4) provides that it is the responsibility of the undersigned, state agencies, and local governments to provide for cooperation and coordination of activities relating to emergency mitigation preparedness, response, and recovery among agencies and officials of this state and with similar agencies and officials of other states and with other private and quasi-official organizations." (Governor NC 2021) This shows that governing agencies recognize their need to mitigate more effectively and in conjunction with other organizations.

The impact of TS Fred is still being felt around WNC. With warnings that are serious enough to constitute an evacuation order, a household, neighborhood, or community’s response needs often reach beyond their homes. The potential for long-term mental and emotional trauma is greater in a situation where there is a lack of training, resources, or support systems (Wong 2018). Warnings are only effective when there is a strong foundation of resilience before, during, and after the disaster itself. High-level climate and weather scientists need to work directly with community organizations to support people with psychological and social resources. Addressing DRR from a mental health perspective encourages resilience and empowers decision-making in the face of increasing weather-related dangers. (Wong 2018). Organizations that can establish this kind of intervention are an essential bridge, or agency, for furthering successful adaptation.

b. *Vulnerability Map*

To determine if TS Fred impacted vulnerable communities, I partnered with the National Environmental Modeling and Analysis Center (NEMAC) to create the desired map. We pulled data from several open sources to create a map overlaying social vulnerability with flood risk (Figure 2). The details of this project follow.

First, we located the Climate Resilience Estimates (CRE) (U.S. Census 2021) data, which the U.S. Census Bureau created and maintains. The Census defines community resilience as the ability of individuals and households to withstand a disaster's potential damages. Individual and household information from the 2019 American Community Survey (ACS) and the Population Estimates Program (PEP) provided to the Census were used to create the 2019 Community Resilience Estimates (CRE). The American Community Survey (ACS) provides detailed information about the population and housing in the U.S. The Census Bureau Program produces and publishes estimates of the population living at a given time within a geographic entity, while PEP uses the auxiliary population data. Tracts, such as age group, race and ethnicity, and sex, measure this data. “Each individual is assigned a 0 or 1 for each component based on individual or household attributes. The result is an index that produces aggregate-level (tract, county, and state) small-area estimates: the CRE. The

CRE provides an estimate for the number of people with a specific number of social vulnerabilities. In its current data file layout form, the estimates are categorized into three groups: zero, one-two, or three plus social vulnerability components. After the weighted estimates are categorized, small-area modeling techniques are utilized to create the estimates for the CRE." (U.S. Census 2021) Using the CRE dataset for populations in Haywood and Buncombe counties, NEMAC and I selected the PRED3_PE (U.S. Census 2021) values, which correlated to populations of any three or more risk factors. The resulting shapefile applied in ArcGIS obtained the first layer of our map, showing the most vulnerable populations in darker shades.

The second layer of the map includes the CDC's Social Vulnerability Index (SVI). "ATSDR's Geospatial Research, Analysis & Services Program (GRASP) created the Centers for Disease Control and Prevention Social Vulnerability Index (SVI) to help public health officials and emergency response planners identify and map the communities that will most likely need support before, during, and after a hazardous event." (ATSDR 2021) Relative vulnerability is subdivided into tracts for which the Census collects statistical data. SVI ranks the tracts on 15 social factors, including unemployment, minority status, and disability, and further groups them into four related themes (RPL Themes). These four themes are socioeconomic status, racial and ethnic minority status, household characteristics and housing type, and transportation. Our map utilized all four RPL themes. These themes represent percentile ranks in proportion to counties that are equal to or lower than a county of interest in terms of social vulnerability. For example, as J. Danielle Sharpe, PhD, a Geospatial Epidemiologist with the SVI, puts it, "an SVI ranking of 0.95 for a county (or tract) of interest signifies that a county (or tract) is more socially vulnerable than 95% of all other counties in an area. Thus, it is highly vulnerable (2021 personal communication)."

The CRE and SVI datasets are depicted in shades of grey on the map, darkening areas of denser or higher vulnerability. The demographic profiles for vulnerability are the main difference between the CRE and the SVI; inherently, there may be some overlap in those two datasets. For example, if an elderly, disabled person lives in Haywood County, their information may show up in the CRE for their age and in the SVI for their disability. That distinction is recognized here but doesn't reflect a problem in this research.

Our last map layer utilizes the NC One Map for North Carolina Effective Flood Zones data. This data was created through a strategic partnership between the Federal Emergency Management Agency (FEMA) and the Carolina Cooperating Technical Partner State. The state encompasses ownership of the National Flood Insurance Program (NFIP) and the Flood Insurance Rate Maps (FIRMs), so the partnership generated a primary tool and map to mitigate flooding areas. These areas, marked on our map by the thin blue lines, are boundary areas defined by the engineering models dating back over 100 years. (NC One Map 2021)

These three layers are mapped together in Figure 2 within the boundaries of WNC's Haywood and Buncombe counties and Townships to highlight geographical areas of vulnerability. Light grey (24-44%) areas are the least vulnerable populations, whereas dark grey (63-93%) areas show high vulnerability. Flood risk data is mapped in blue; the more blue an area is, the higher the risk. As we observe the map, we see that high vulnerability and the most devastating impacts of TS Fred correlate in several

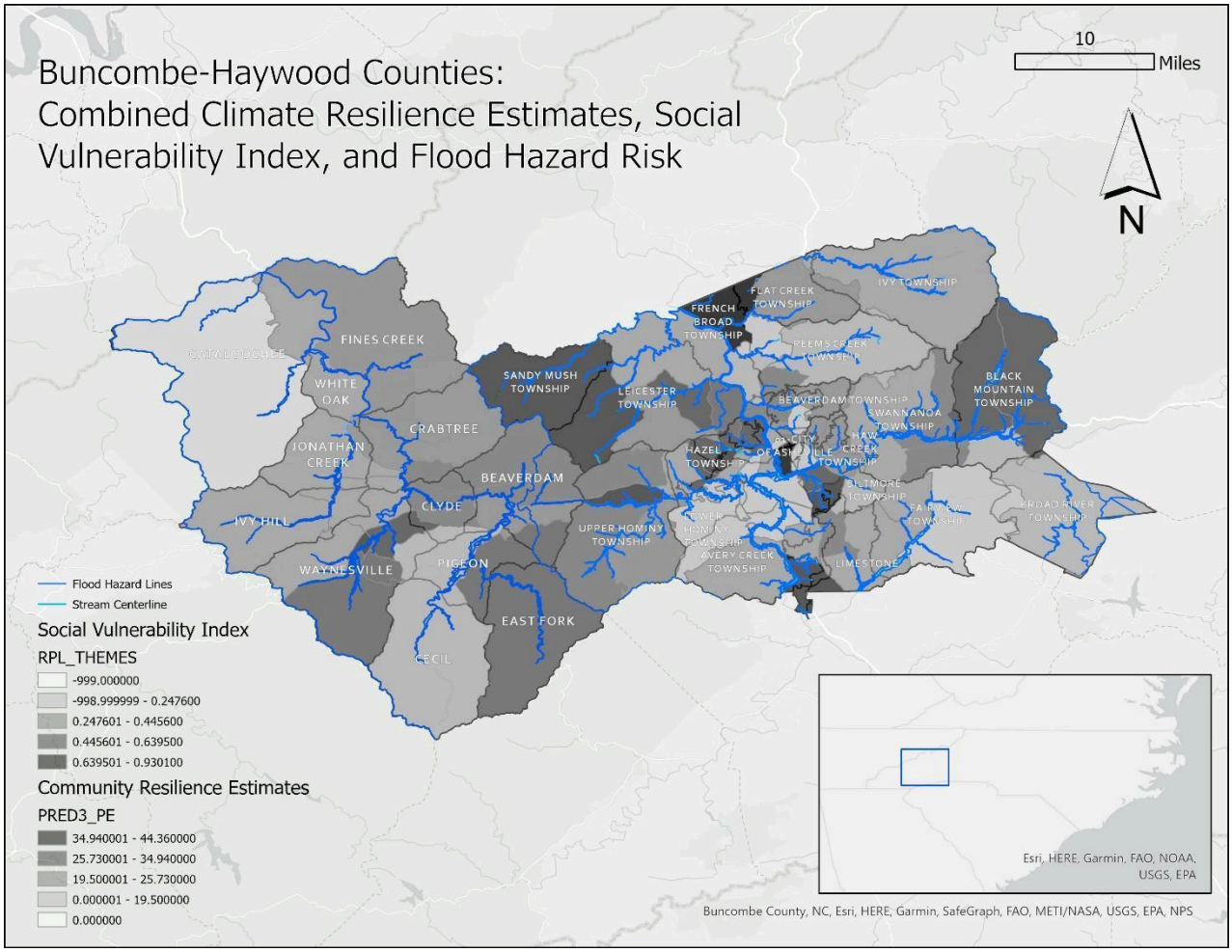

Figure 2: Vulnerability Map of Buncombe and Haywood Counties, including flood risk data and social vulnerability indices from multiple sources.

areas. Dark grey areas with a lot of blue correspond to areas of highest risk from environmental and social factors. Specifically, the highly vulnerable (darkest grey) area just north of Upper Hominy Township is the location of the towns Candler and Canton. The map shows 63% and up vulnerability in this area that was heavily affected by Fred's floodwaters. The town of Cruzo, devastated by the storm, is in the East Fork Township. There is a medium grey vulnerability (44-63%) but a very high flood risk shown there. The Pigeon River Basin is in Haywood County only and is depicted in the western portion of the map. We can also observe that the areas marked Clyde and the eastern area marked Pigeon are darker grey, denoting a population range of 45-65% more vulnerability than its surroundings. These areas also correlate to TS Fred's reported damages and adverse impacts.

It is worth noting that the data used needs improvement in two areas, which is evident on the map. The areas of land belonging to the indigenous Cherokee Reservation (west of Clyde), the Cherokee National Forest, Biltmore Forest, and Biltmore Estate (located south of Asheville, marked as Lower Hominy Township) are both lightly colored, indicating less vulnerability. If we ignore population density since some of these areas have dense forests, the map shows one of two things: either they

are not as vulnerable, or there is insufficient data on them. It is local common knowledge that these areas regularly incur damages by flooding in both areas, so one can assume the latter. This reinforces the need for Census data. A changing climate affects all life on the planet, and the need for collaboration is paramount to our success in planning mitigation and resilience on all fronts, including data. Open-source, reliable data is part of the progress of climate justice. Some shared methods and technologies could be strategic in global empowerment efforts.

The launch of NCEI's (formally the NCDC) (NOAA 2021) tool shares interests and ambitions similar to my results. Not only is there awareness of the need to blend empowerment with vulnerability, but action is also taking place to improve the situation. On 10 November 2021, NCEI, located in Asheville, NC, in conjunction with its overarching authority, the National Oceanic and Atmospheric Administration (NOAA) launched its County-Level Risk and Vulnerability Tool. This mapping tool is intended to provide the U.S. with information and guidance on vulnerability to climate and weather-related events and present analytics for future potential impacts. The data used to make these maps comes from the FEMA National Risk Index (NRI), the Social Vulnerability Index (SoVI), and the spatial distributions of the projected damages and socioeconomic metrics. Therefore, the resulting mapping tool is a similar blend of data to the one I attempted to create with NEMAC. The NCEI's platform is easy to use and well-organized, featuring forty years of natural disaster events, reports, and data. The merging of risk factors and vulnerability combined with the distribution of climate disaster damages is a polished version of the attempted project. The intelligence of this tool can grow to become highly effective in our attempts to mitigate the issues at hand. Data for their maps can be found here: FEMA National Risk Index (NRI) (FEMA 2021), Social Vulnerability Index (SoVI) (HVRI 2014), and the Climate Impact Lab. (Note: the SVI and SoVI are not the same, although they are both Social Vulnerability indexes.) (NOAA 2021)

Using NCEI's Tool, assistance with hazard mitigation and preparation from homeowners to community planners or even emergency managers is available at a baseline minimum of risk factors. The mapping tool looks at the broader strokes of data for the entire country as directly impacted by natural disasters, so some indirect impacts are not considered. Some complex economic interdependencies would require a finer detailed risk analysis. According to the NCEI's report (NCEI 2021), the Southeastern U.S. has recently experienced a higher frequency and cost of disaster events. This region is projected to have more significant impacts due to the large densities of vulnerable populations and in-migration.

c. Survey Results

I performed a survey to determine the response capacity of the community in both Buncombe and Haywood counties. The survey presented a series of questions regarding TS Fred flood warnings, including but not limited to response capacity and personal experience before, during, and after the event, recommendations for the municipal community, and perceptions of emergency response tactics. I invited local government and emergency management members in both counties and local staff members at NOAA and FEMA to participate. Most other respondents were community

members of the University of North Carolina at Asheville (UNCA). There were twenty-one participants in total.

Unanimously, respondents confirmed that they worry about the changing climate, as shown in Figure 3. They also all expressed that they would engage with or support a community project centered around preparing their immediate community for disaster resilience and empowerment to protect livability (Figure 4). This shows genuine, untapped community interest in being more prepared for disasters. Regarding the flood warnings, every subject except one received a warning or multiple warnings, but only 90% responded immediately, as shown in Figure 5.

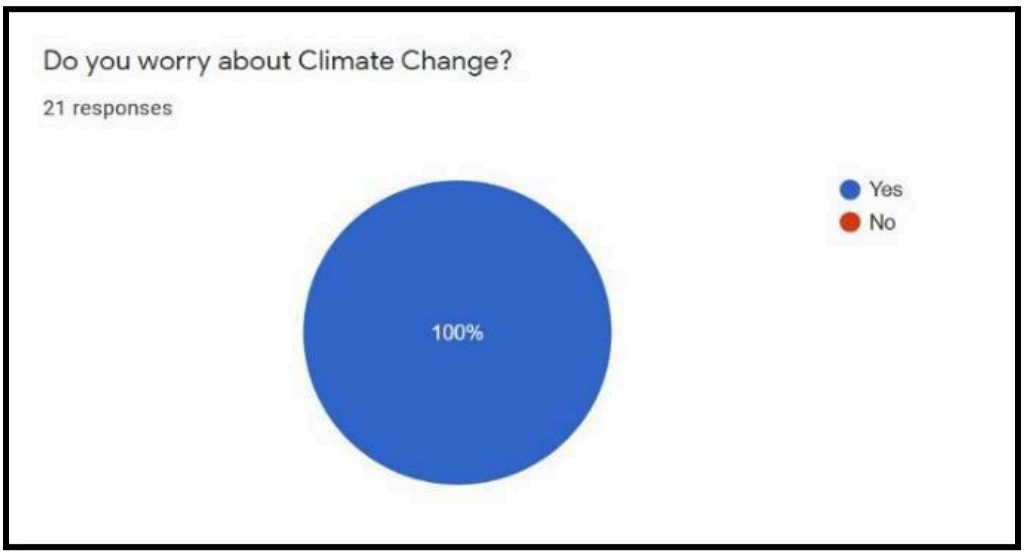

Figure 3: Survey Results addressing worry regarding climate change

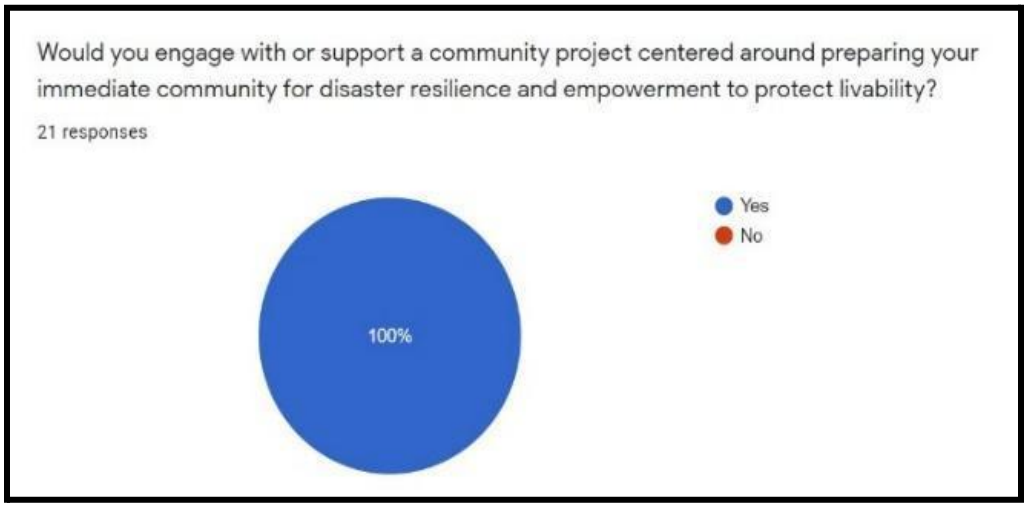

Figure 4: Survey Results of community-based resilience participation

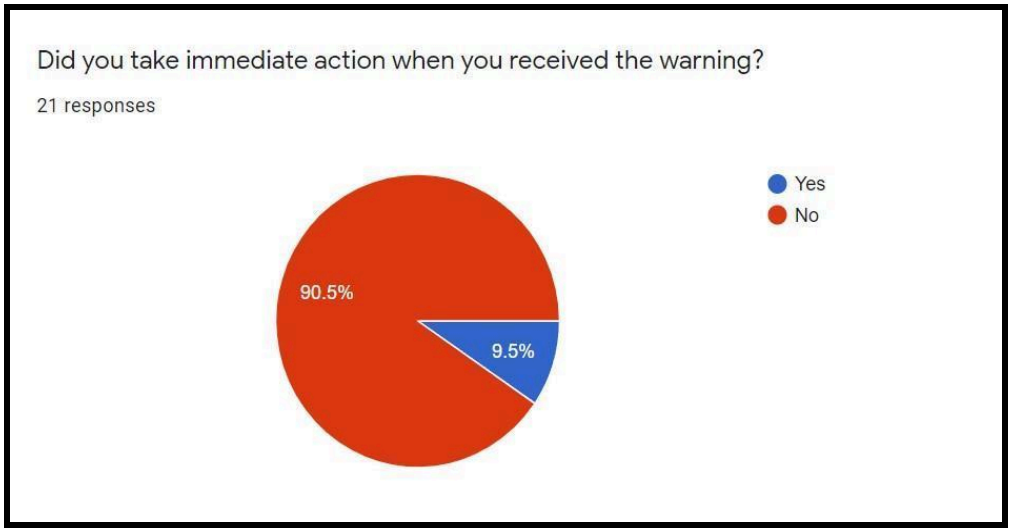

Figure 5: Survey Results about immediate action after warning

This non-action is partially explained by a question that revealed that 43% of the participants did not know what to do. This group reported feeling unempowered to act and needed more resources to do anything. Essentially, they needed to prepare. One-third of the participants were in the flood zone and understood the warning they received, yet still, they did nothing. Furthermore, people who are safe by staying where they are could participate in helpful actions to ensure the safety of others in their community. If trained, they could report observations or use social media to coordinate relief efforts. 29% of the subjects had their power or water supply interrupted by TS Fred. 62% reported experiencing transportation issues like blocked roads or high traffic. Several of them drove through flooded waters to get home.

When asked what recommendations they had for the municipal community of WNC to improve disaster preparedness, the respondents suggested enhanced building codes and improved infrastructure, educational programs, and reinforced roads. Several requests were to reinforce mountain road infrastructure, specifically addressing drainage and creating better ditches, dams, and bridges. Flood victims also suggested building zone limitations and implementing evacuation procedures. The survey also asked, “From your perspective, were the most vulnerable communities in WNC protected in this emergency?” Almost half of the responders said no.

When asked for suggestions for WNC’s ordinary citizens regarding disaster risk management, these themes emerged: listen to the warnings, make an emergency plan, and be prepared. Several suggestions were around following directions and listening closely to local guidance. Additional suggestions were to spread the word. So, evidence revealed a group of people who, for the most part, did nearly nothing to respond immediately to the warnings, subsequently regretting that action, and who are now willing to take action to be more prepared in the future. They also expressed a willingness to take these situations more seriously and empower others to do the same. 83% of the survey respondents reported they did not know of CERT. Community Emergency

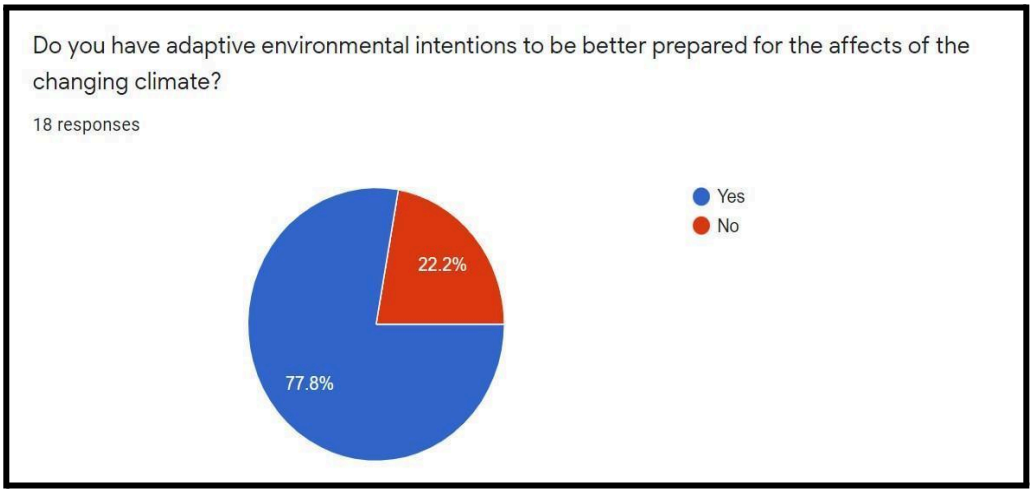

Figure 6: Survey Results Adaptive Intent

Response Team, CERT, is a program that educates volunteers about disaster preparedness. It trains people in basic response skills, such as fire safety, search and rescue protocols, and some basic medical knowledge. According to my survey, this may be an excellent place to start some essential strengthening of our community resilience.

As mentioned earlier, the greatest discovery within the survey results was a unilateral result where 100% of the participants said they would support a community project centered around preparing their community for resilience and empowerment to protect livability. Everyone said they worry about the changing climate, and, as seen in Figure 6, 78% said they want to adapt.

A previously performed survey from 2018 (Wong) revealed an in-depth analysis supporting the need for preparedness efforts to go beyond policy to focus on developing comprehensive programs that build human capital and resources. The public is an untapped asset available to increase the effectiveness of an emergency warning.

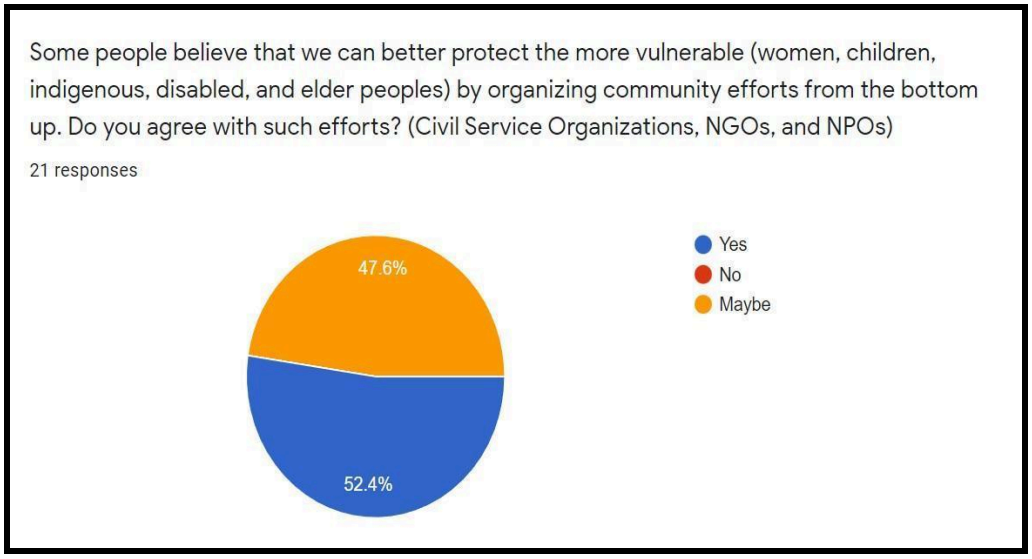

Figure 7: Survey Results about supporting community efforts

DISCUSSION

These survey results expose the need for empowerment while driving the conditions under which warnings can improve efficacy. Success requires both clear, timely communication and the agency to respond. The weather community needs to inform people as precisely as possible, but they also need the ability to interpret and apply the information to their circumstances.

For example, for a flood warning to be effective, it must be communicated by the governing authority within a reasonable time frame, with the scientific conditions to support it. Emergency Management agencies and their resource partners must be ready to respond quickly and swiftly. Trained aid organizations should be able to assemble immediately. This type of resilience planning has a clear path. However, the general population or ordinary citizens, especially the most vulnerable, need the capacity to take responsible action.

We need training to master quick reactions in intense situations. Combining bottom-up community engagement programs with top-down policy and decision-makers can reinforce our preparedness for weather-related disasters like floods. Even basic neighborly or neighborhood-sized projects could save lives. Through increased collaboration, governing authorities and the public can improve their agency methods, possibly avoiding many of the adverse impacts of severe flooding events.

RECOMMENDATIONS

When a flood warning is issued, it should have appropriate reach and be understandable. People should be encouraged to have their phones set up to receive warnings and be able to comprehend what the warning is saying entirely. For example, there are differences between a flood warning and a flash flood emergency alert. Particular attention should be given to people living in basement apartments or low-lying areas at greater risk (Hensen 2021). This means that the efforts and technology of the issuing authority should bridge any potential language barriers (Perera 2020). Furthermore, the warning recipients must trust the authority and be motivated enough by the information to take proper action. Scientists can widen their reach by delivering warnings with more straightforward instructions, follow-up steps, and guidance on how people can help each other. Collaborative communication could include partnerships between meteorologists, epidemiologists, and ecologists to improve warnings for climatologically vulnerable areas (Shimamoto 2017). Digital volunteers are a hugely untapped resource who can handle sharing information on social media about aid, organizing information about stranded people, medical conditions, food distributions, etc. Marrying this technology with the emergency warning systems and making a lasting, positive impact is possible, in addition to the potential usefulness of the data collected during such events for future planning, mitigation, and potential DRR cartography (Song, 2020).

Encouraging privatized weather forecasting may sometimes become a solution, as less proverbial “red tape” may allow information to be received in a new way more quickly through federal means. Private forecasters may be able to build community-oriented partnerships in their immediate environments more rapidly than the

national networks allow. Efforts from these groups may encourage empowerment and education to spread to the more vulnerable quickly.

What helps people the most in these warning messages is action-oriented information. Suppose forecasters get hung up on getting the forecast correctly and deliver messages ensconced in meteorological jargon. In that case, it just flies over people's heads, especially in a stressful situation. People need clear, concise instructions that confidently go right to their needs. For example, a warning, "Major flood impacts expected for urban areas," says nothing compared to a warning, "Traveling anywhere in Candler is dangerous right now." Governing authorities and scientists can consider building more resilience knowledge into warnings.

Response to extreme flooding depends on the strength of strategic plans, training, adaptation ability, and resources. Since needs arise rapidly in a crisis, leaders require a powerful medium to anticipate the needs of the many. This occurs not only in technology but also in relationships. The most effective warning is fully supported by well-organized, coordinated action by decision makers, emergency managers, strategic planners, community organizations, and finally, by direct community engagement. To create more effective warnings, ordinary citizens need empowerment. Intentional educational strategies must be organized and offered. Universities, such as the UNC system in North Carolina, are great places to host workshops like CERT. This research suggests that the government can do much more to empower its constituents.

Scientists have a responsibility to enhance and improve messages. We could consider the modernization of the alert structure as a fundamental branch of the necessary transformative social changes needed for success. Perhaps drafting simulations of compounding extreme weather events could provide a "style guide" for the weather community, laying out a baseline of effective language. Of course, every community is different, so every weather service provider must articulate appropriate language for their audience. For example, in WNC, we must consider language that makes sense for mountainous terrain, poor road conditions, and high flooding risks. Incorporating vulnerability and risk assessments into preparations will improve response capacity. The challenge for forecasters is exacerbated by real-time extreme events that develop overlapping warnings. These situations require swift coordination and correctness. To create this level of efficacy, we need enhanced partnerships.

I recommend that we build partnerships between the civic, public, and private sectors. Blending partner organizations and sharing resources between sectors can enhance efforts to mitigate potential loss and damages at all levels. Governing authorities, emergency management, climatologists, forecast meteorologists, environmentalists, activists, architects, builders, and planners are a few groups that may help the cause by forming partnerships. Research shows people are interested in securing and retaining livability.

CONCLUSION

To combat a changing climate, we need to increase our response capacity, especially in our most vulnerable communities. In WNC, this is especially true in rural, agricultural areas at higher risk for flash floods. Reinforced infrastructure, improved development planning, and strategic funding for resilience efforts are needed to

empower the vulnerable further. New scientific tools are being developed, and brilliant community-led programs are emerging all over the U.S. An eventual blend of these two assets is inevitable.

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APPENDIX A: LOCAL RESOURCES

- U.S. Climate Resilience Toolkit: https://toolkit.climate.gov/
- Asheville's Climate Justice Initiative:
- https://www.ashevillenc.gov/department/sustainability/climate-initiatives/climate-justice-initiative/
- CERT Training: https://www.ready.gov/cert
- Free FEMA CERT online course (can be taken in 2hrs, good to do while waiting for physical class to be offered): https://emilms.fema.gov/is_0317a/curriculum/1.html
- Cool City Challenge: https://coolcity.earth/
- Cool Block: https://coolblock.org/
- NC Climate Justice Info: https://www.ncclimatejustice.info/
- NCEI's Risk Assessment Tool: https://www.ncdc.noaa.gov/billions/mapping
- Volunteer in Relief Efforts: https://www.nc.gov/volunteer/volunteer-opportunities
- Get a Disaster Preparedness Kit: https://www.readync.gov/plan-and-prepare/get-kit
- Make a Donation to Haywood County: https://www.haywoodchamber.com/tropical-storm-fred-emergency-relief/

Complete Survey Results are open to anyone with a UNCA email address at this link: (https://docs.google.com/spreadsheets/d/1cKFuVlOe93pu996k7RkWRU5Ros1qQjGUv3rS3wHQoto/edit?usp=sharing)
A PDF of the results is available upon request @ lcox1@alumni.unca.edu